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OUTLINE OF AN URBAN EDUCATIONAL MODEL.

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THIS TECHNICAL NOTE IS A NONTECHNICAL DISCUSSION OF THE URBAN EDUCATION MODEL, AN ANALYTIC, SYMOBLIC MODEL TO BE USED IN PLANNING THE LOCATION AND ENROLLMENT SIZE OF URBAN SCHOOLS. AMONG THE EDUCATIONAL ALTERNATIVES THAT MAY BE CONSIDERED BY THE METHODOLOGY PRESENTED ARE THE "GREAT HIGH SCHOOLS" AND THE "EDUCATIONAL PARKS." THE CENTRAL ORIENTATION OF THE URBAN EDUCATIONAL MODEL IS PLANNING THE LOCATION AND ENROLLMENT SIZE OF ELEMENTARY AND SECONDARY SCHOOL PLANTS. FOUR SUB-MODELS COMPOSE THE GENERAL URBAN EDUCATION MODEL. THE URBAN SUB-MODEL DETERMINES ATTENDANCE AREA BOUNDARIES BY ASSIGNING PUPILS TO SCHOOLS SO AS TO ACHIEVE GIVEN OBJECTIVES. THE SCHOOL SUB-MODEL ESTIMATES SPACE AND STAFF REQUIREMENTS PER SCHOOL. THE COST SUB-MODEL ESTIMATES THE COST IMPLICATIONS OF ATTENDANCE AREA BOUNDARIES AND SPACE-STAFF REQUIREMENTS. THE EFFECTIVENESS SUB-MODEL ASSURES THAT A PREDICTION OF ACHIEVEMENT LEVELS ON AN AGGREGATED SCHOOL PLANT BASIS MAY BE MADE BASED ON THE VARIABLES DEFINED IN OTHER SUB-MODELS, THAT IS STUDENT SOCIOECONOMIC AND SCHOOL VARIABLES. THE MODEL DOES NOT YIELD A "SOLUTION" BUT DOES PROVIDE AN ARRAY OF MEASURES OF POTENTIAL USE TO THE SCHOOL ADMINISTRATOR. EA 001 235 IS A RELATED DOCUMENT. (HW)

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NATIONAL CENTER FOR EDUCATIONAL STATISTICS
Division of Operations Analysis

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OUTLINE OF AN URBAN EDUCATIONAL MODEL

Planning School Plants

It is generally accepted today that educational policy as exercised by urban school administrators is inextricably linked with the aspirations of the city as a whole. The school administrator is required to plan facilities and programs that promote general city-wide social, racial and economic progress as well as educational progress. In response to this, urban school administrators plan for the replacement of outdated and ill-equipped school plants in order to achieve the stature for new center city schools that will attract the middle class families of the suburbs. Stated goals of the new schools have been "viable racial balance" and "varied economic composition." A recent survey by the Center for Urban Education (New York) indicated that 85 out of 457 cities were either building or planning to build large educational complexes containing the latest in modern and special facilities.

It is evident that for a meaningful evaluation of alternatives, in the scope of the "Great High Schools" and "Educational Parks," a methodology for the systematic definition and evaluation of alternatives is needed. A truism as reported by the Educational Facilities Laboratory is, "no longer can schools be located by spot map, putting schools wherever the dots (children) are clustered." The Urban Education Model is a step in the direction of the planning methodology that is now required by the city school administrators, a methodology for the systematic statement and evaluation of alternatives.

Model Process

The central orientation of the Urban Education Model is planning the location and enrollment size of elementary and secondary school plants. Four Sub-models compose the general Urban Education Model. Though each is useful alone, the solution of one Sub-model provides outputs which become inputs for the solution of another. The sequence of computations outlined below is productive of maximum analytic pay-off.

The Urban Sub-model determines attendance area boundaries by assigning pupils to schools so as to achieve one of three objectives:

- to minimize the money costs of transporting pupils to and and from school
- to minimize the time pupils spend in traveling to and from school
- to minimize the distance pupils go in traveling to and from school

The objective chosen is achieved so as to satisfy certain constraints which educators may wish to place on the composition of the student body in each school. These constraints assume that some desired combination of age, race, and social class exists. A model user may compare, for example, the attendance area boundaries minimizing student transportation costs for schools with no less than a thirty percent racial minority to the boundaries achieving the same transport objective with no less than a forty percent racial minority. Model users must have these data in order to determine such attendance areas:

- Student population, by age, race, and social class
- Location of existing and planned school plants
- Money costs, or time spent, or distance for transportation of the student population

Having determined which students will attend which schools, educators may estimate space and staff requirements per school using the School Sub-model. This Sub-model enables educators to estimate total space and total staff needed for a given student body and to see how these requirements vary as:

- Staff utilization patterns vary
- Programs and curricula vary
- Space utilization patterns vary

Users of this Sub-model need these data:

- Total student population for given schools
- Staff-student ratios for planned levels of staff utilization and program content
- Space per student required for planned curricula and programs

Of importance to planners of educational facilities are the cost implications of attendance area boundaries and space-staff requirements. The Cost Sub-model uses data from the other Sub-models to estimate these implications. The estimates include:

- Construction and renovation of school plant costs
- Costs of acquiring land
- Initial and operating costs of bus transportation for students
- Special equipment costs

- Staff costs and other current operating costs
- Costs of capital financing

The general character of this cost format enables the application of this Sub-model to districts whose cost accounting procedures vary greatly. Data requirements do not necessitate massive bookkeeping changes by Model users. Data needs include, for example:

- Total salary expenditures for a given year and for a given school
- Total number of employees of the school under analysis for given year
- Number of students desiring bus transportation
- Capacity of buses owned by the district used for a given school
- Distance travelled by buses transporting students to and from the school

A desirable feature of the Cost Sub-model is that it has six distinctly separate cost components. A user might use only those components for which he has data. This exemplifies the flexibility which users will find in the entire Urban Education Model. It is designed to meet many or few analytic needs and to utilize available data. It is hoped that it will be operational up to the level of data availability of any local school district in which planning needs are felt.

The Effectiveness Sub-Model is essentially a "plug-in" model. It assumes that a prediction of achievement levels on an aggregated school plant basis may be made based on the variables defined in the other Sub-models, that is student socioeconomic and school variables. That this can be done with sufficient precision has been amply demonstrated

by several major studies including the Office of Education's Equal Opportunity Survey.

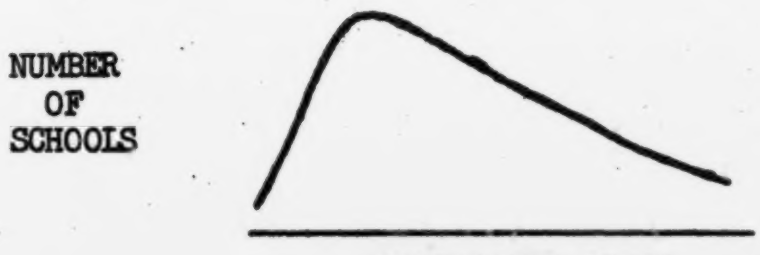
To employ this aspect of the model it is necessary to have individual student achievement data, and the corresponding family and school data associated with the individual student. Once these data are available, standard computerized multiple regression techniques may be employed to yield estimates of school achievement levels.

Evaluation of Alternatives

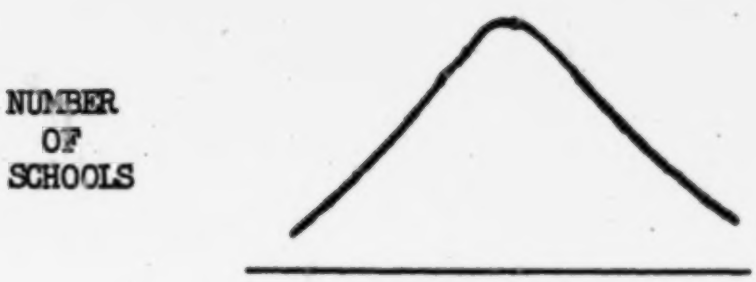
Many outputs are generated by the above process. These are generated for each alternative policy specified by the educational decision maker. One alternative might specify a given location, another a particular grade grouping, another a particular enrollment size for the new school plant, another a particular racial balance and so forth. The set of data produced by the model process are summarized in the following table:

Measure	Schools: Elementary	Schools: Secondary
1. Predicted Achievement Level	$\bar{x}_1\ \bar{x}_2 \dots \bar{x}_n$	$\bar{x}_{n+1} \dots \bar{x}_m$
2. Racial Composition	$R_1\ R_2 \dots R_n$	$R_{n+1} \dots R_m$
3. Social Composition		
4. Distance Metric		
(a) Average	. .	. .
(b) Maximum	. .	. .
(c) Minimum	. .	. .
	. .	. .
5. Cost		
(a) Initial		
(1) Buildings		
(2) Equipment		
(b) Current		
(1) Salaries		
(2) Other		
(c) Cost per pupil	$\bar{c}_1\ \bar{c}_2 \dots \bar{c}_n$	$\bar{c}_{n+1} \dots \bar{c}_m$

It is difficult to use several output measures as a basis for making a decision. In the face of incommensurate data however there are few alternatives. One way of looking at the data which may be helpful in interpreting and summarizing the data is the following. Consider for example the distribution of each measure over the various schools. The distribution of predicted achievement levels may look like the following,

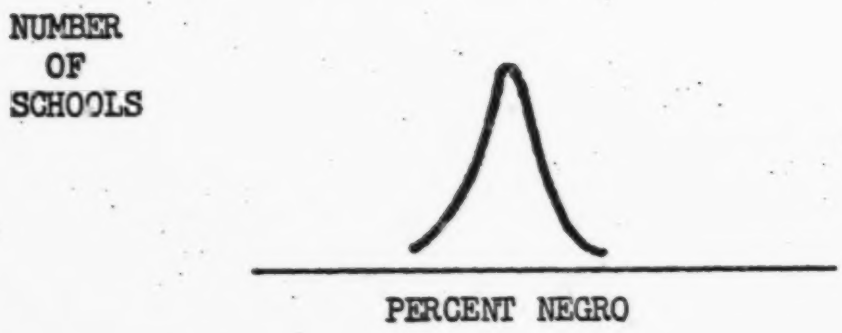


The corresponding distribution on a national scale may look like



One way to measure the disparity between the predicted and national distributions is in percentiles relative to the national norm, such as, 80 percent of the schools are predicted to be below the national achievement norms.

A similar approach may be made with other output measures. In some cases the norm may be more obvious and readily specified. For example the norm for racial balance may look like,



i.e., near a constant percentage.

The actual distribution may look like,

which is the distribution current in many central cities.

In any case the model does not yield a "solution." It provides an array of measures which, hopefully, is meaningful to the school administrator and upon which a decision may be based. It is hoped that, in narrowing the area in which intuition is the only guide, better decisions may be made in the long run.

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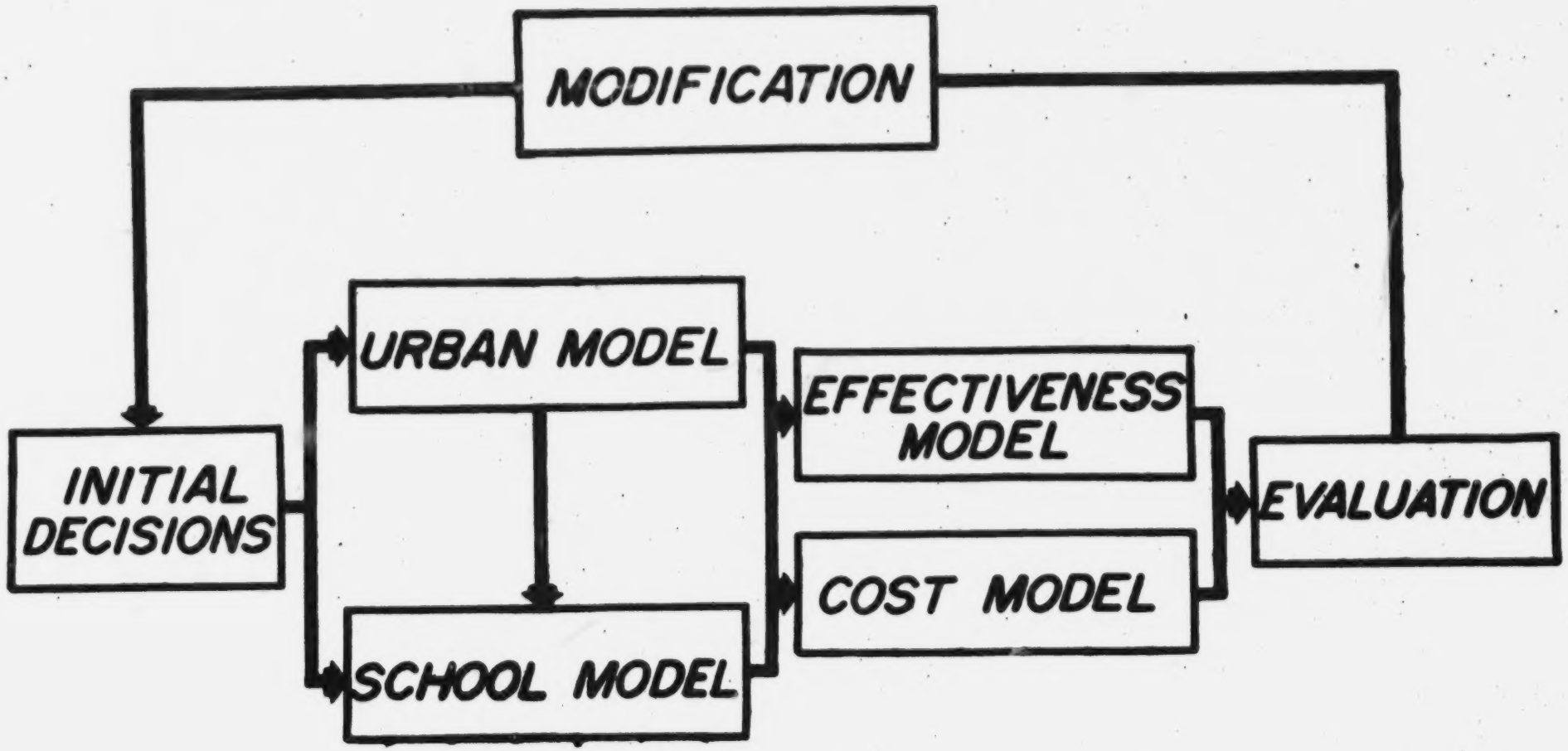
SYSTEM OVERVIEW



URBAN MODEL

INPUT

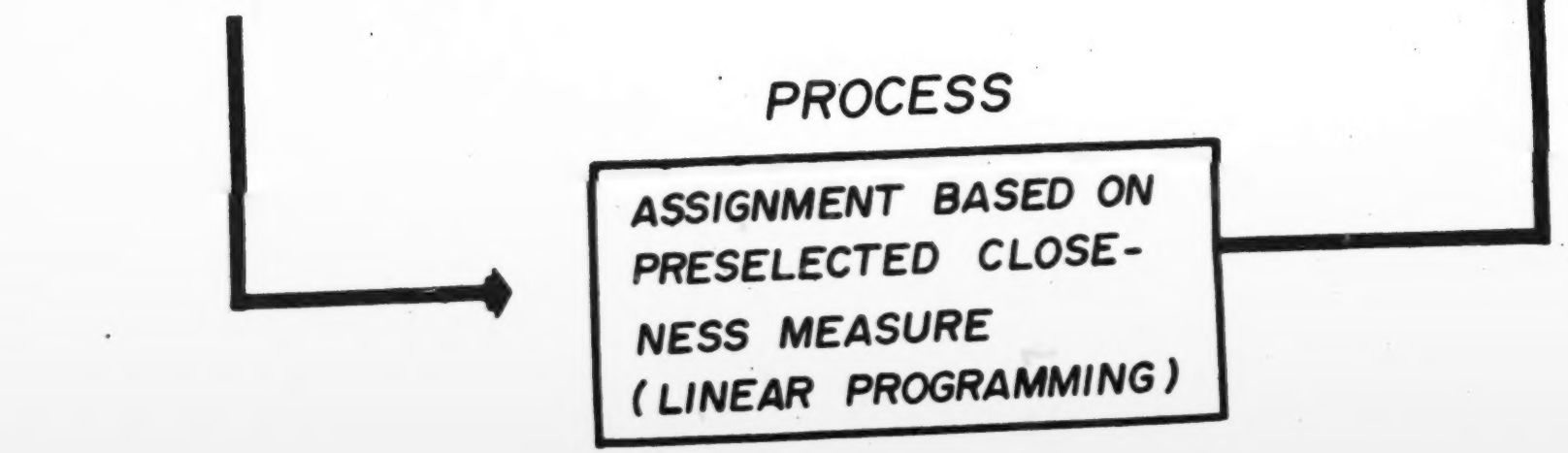
1. SCHOOL PLANTS
   - LOCATION
   - CAPACITY
   - LEVEL

2. STUDENTS
   - AGE
   - RACIAL
   - SOCIAL
   - LOCATION

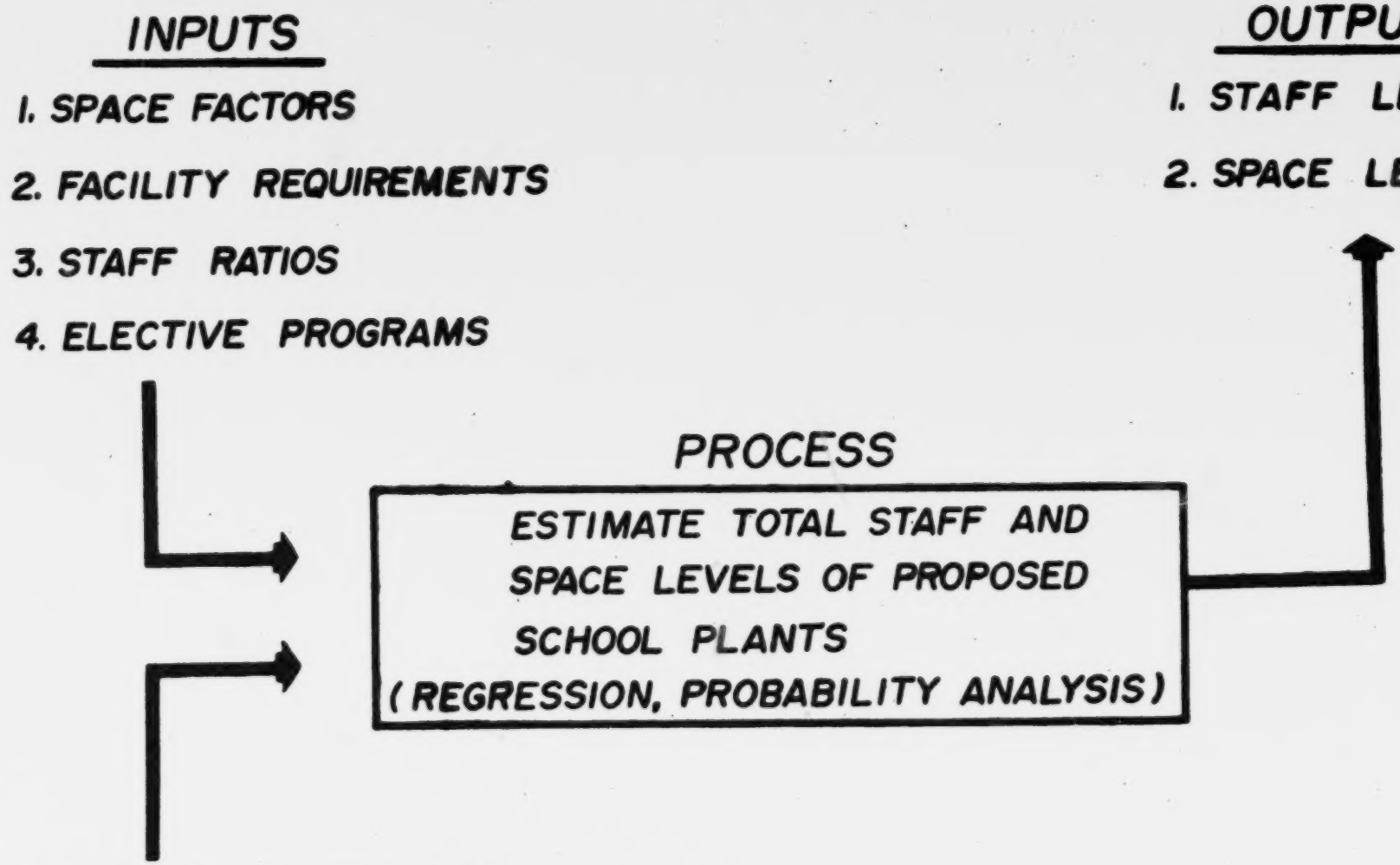
3. SCHOOL PLANT RACIAL AND SOCIAL RANGES

OUTPUT

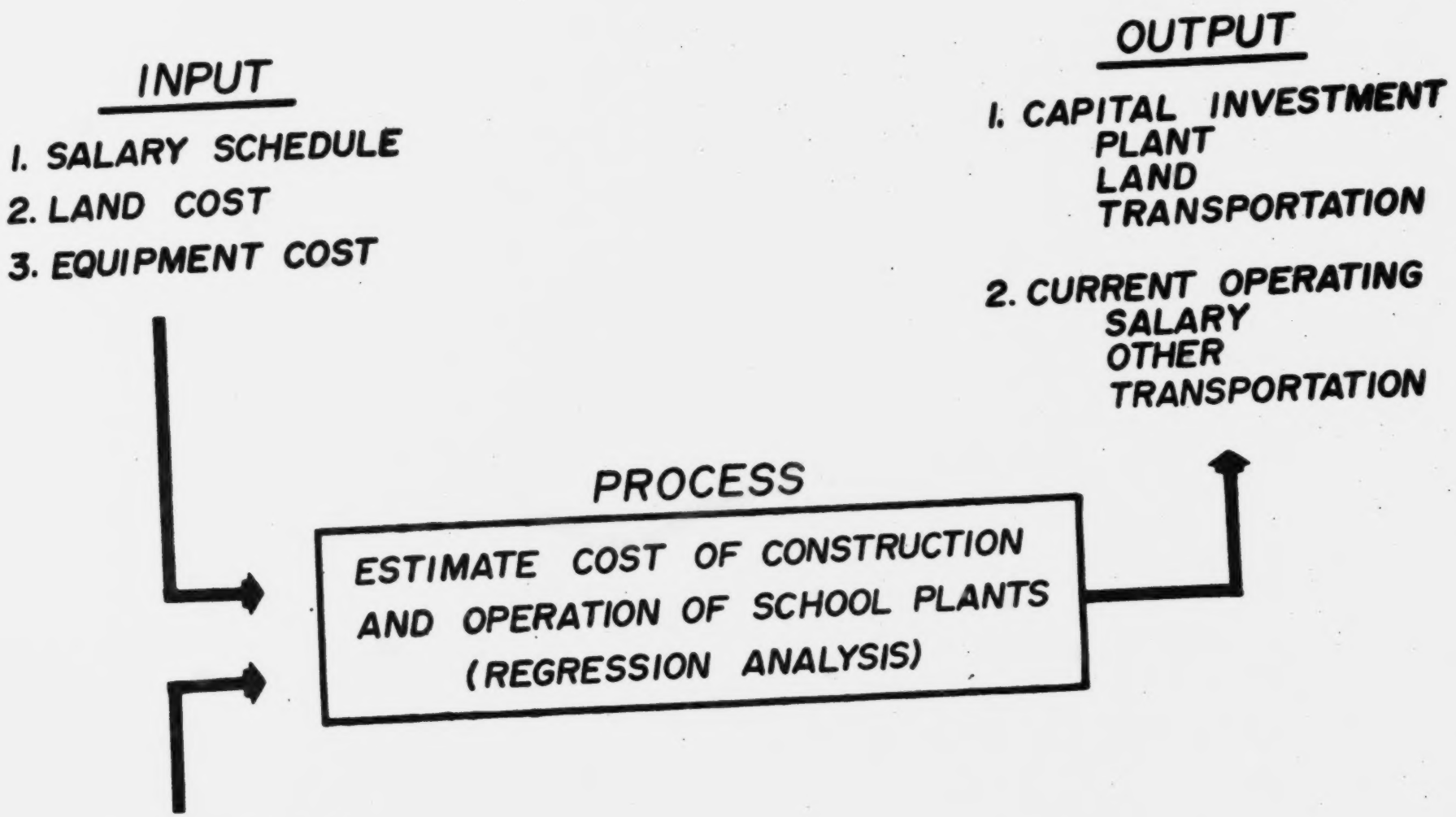
1. ASSIGNMENT OF STUDENTS TO SCHOOLS
2. ENROLLMENTS AT EACH SCHOOL PLANT
3. ACHIEVED LEVELS OF RACIAL AND SOCIAL BALANCE
4. STUDENT DISTANCE MEASURES



SCHOOL MODEL



COST MODEL


INPUT
1. SALARY SCHEDULE
2. LAND COST
3. EQUIPMENT COST
4. SPACE LEVELS
5. STAFF LEVELS
6. STUDENT DISTANCE MEASURES
PROCESS
ESTIMATE COST OF CONSTRUCTION AND OPERATION OF SCHOOL PLANTS (REGRESSION ANALYSIS)
OUTPUT
1. CAPITAL INVESTMENT
PLANT
LAND
TRANSPORTATION
2. CURRENT OPERATING
SALARY
OTHER
TRANSPORTATION

EFFECTIVENESS MODEL

INPUT

1. RACIAL/SOCIAL COMPOSITION
2. EXPENDITURES
3. STUDENT STAFF RATIOS
4. FACILITIES

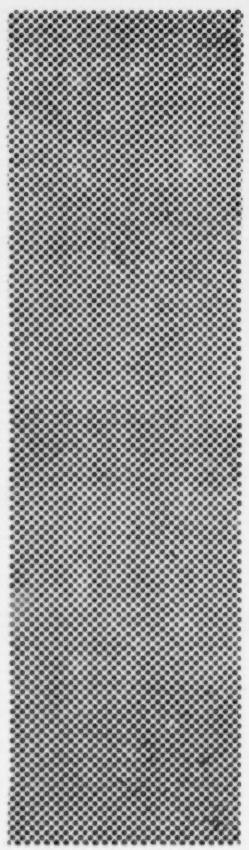
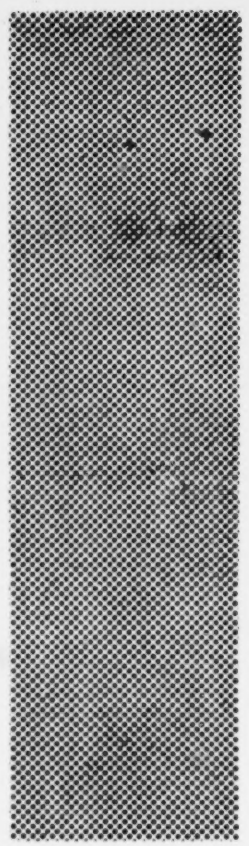
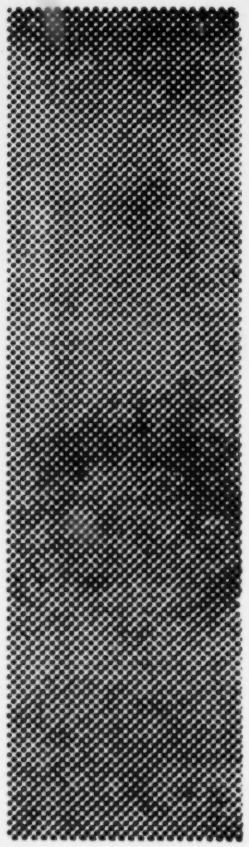
PROCESS

RELATE SCHOOL PLANT ACHIEVEMENT LEVEL TO MODEL VARIABLES (REGRESSION ANALYSIS)

OUTPUT

1. PREDICTED SCHOOL PLANT ACHIEVEMENT LEVEL

EVALUATION

MEASURE	ALTERNATIVE PLANS I	II	III
1. PREDICTED ACHIEVEMENT LEVEL			
2. RACIAL BALANCE			
3. SOCIAL BALANCE			
4. ENROLLMENT SIZE			
5. STUDENT TRAVEL DATA			
6. COST DATA			
7. STAFF LEVELS			
8. MAJOR FACILITIES			